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Organic pollution in culture water resulting from excess feed and metabolite buildup

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Maintenance of water quality is a requisite to successful hatchery operations. An important consideration in water quality control is the effect of contaminants, such as organic matter resulting from excess feed and buildup of metabolites, on the culture water.

To assess the effect of these contaminants, *Penaeus monodon* postlarvae were subjected to increasing feed concentrations and their growth and survival rates were recorded. Measurements were made of dissolved organic matter through the standard 5-day BOD (biochemical oxygen demand) test, DO (dissolved oxygen), and ammonia and nitrite-nitrogen concentrations.

P. monodon postlarvae were stocked at 100 each in 10 aerated aquaria of 6-liter capacity. These were fed minced shrimp meat at concentrations of 10, 50, 100, 250, and 500 mg/L. Duplicate aquaria with diatoms as feed served as control. All experiments were conducted in a controlled environment in the laboratory.

Feeding was done once daily, after removing the excess food particles of the previous day. A diatom density of 10×10^4 to 50×10^4 cells/mL was maintained for supplemental feeding and to aid in the removal of feed decomposition products. One-third of the culture water was replaced daily.

Survival was highest at the lowest feeding level and decreased as the feed concentration increased (Table 1). No postlarva survived the highest feeding level (500 mg/L) on the 2nd day of

Table 1. Survival rate of *P. monodon* postlarvae at varying feed concentrations from P_4 to P_9, with initial stock of 100.

Feed concentration (mg/L)	Survival Rate (%)				
	Day 1 (P_5)	Day 2 (P_6)	Day 3 (P_7)	Day 4 (P_8)	Day 5 (P_9)
10	77	49	37	32	26
50	69	50	34	27	22
100	50	21	12	10	10
250	40	15	6	4	2
500	30	0	–	–	–
Control	65	47	39	32	22

the test period. There was no appreciable difference in growth rates at different feed concentrations, but the rates were double that of the control group (Table 2).

Low DO at high feed concentration suggests that DO levels were insufficient to meet oxygen requirements of the decomposing feed (Fig. 1). A significant drop in DO was accomapnied by mass mortality. With low feeding levels, nitrification became faster as evidenced by high nitrite and low ammonia levels. With high feeding levels, however, low degree of nitrification resulted in accumulation of ammonia in the culture water.

At the feed concentration of 500 mg/L, BOD rose above the initial value (Fig. 2), which shows that the rate of organic pollution was faster than the rate at which organic matter was stabilized by bacterial action. There was a steady decline in BOD when the feeding was stopped due to mass mortality.

At the feed concentration of 250 mg/L, low survival was obtained with BOD values ranging from 12 to 17 mg/L. The best survival rate was obtained at the lowest level of concentration, with BOD values not exceeding 10 mg/L, indicating that BOD values are directly related to survival rate.

Two conclusions can be drawn from this study. First, organic matter enriches the food supply for *P. monodon* postlarvae, but at higher concentration levels it can pollute the culture water, which leads to mass mortality of the postlarvae. Second, the survival rate of *P. monodon* postlarvae is directly related to dissolved organic matter concentration, oxygen tension, and ammonia-nitrogen concentrations in the culture water. Even at sublethal levels these adverse environmental conditions decrease the survival rate.

Table 2. Growth rates of 20 to 25 *P. monodon* at different feed concentrations in 5 days (P_4 to P_9).

Feed concentration (mg/L)	Average increase in weight/fry (mg)	Increase in weight (%)
10	0.29	51.5
50	0.33	57.0
100	0.33	57.0
Control	0.16	27.5

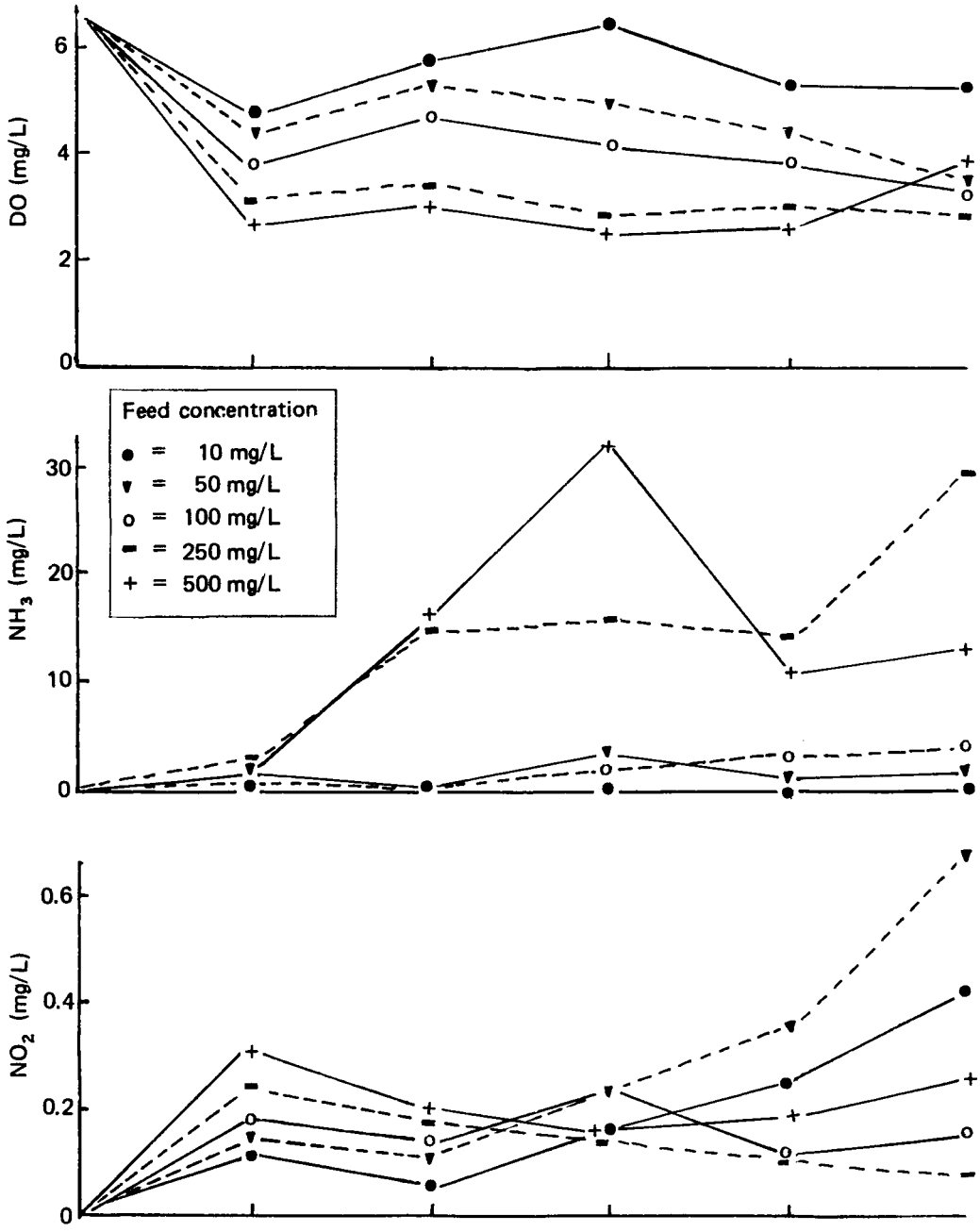

Fig. 1. Effect of shrimp meat feed concentration on DO, NH_3, and NO_2 levels of culture fo *P. monodon* P_4 to P_9.

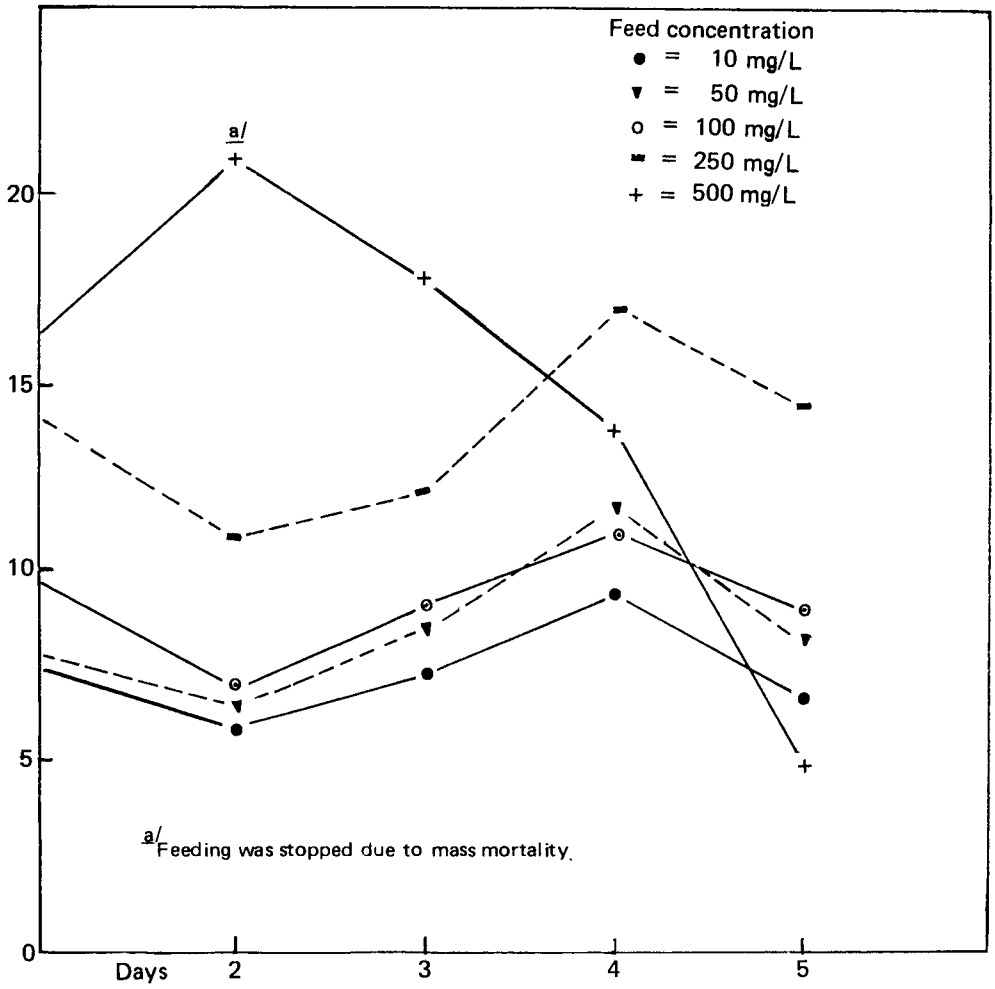

Fig. 2 BOD (biochemical oxygen demand) variations at different feed concentrations in culture water for *P. monodon* postlarvae.